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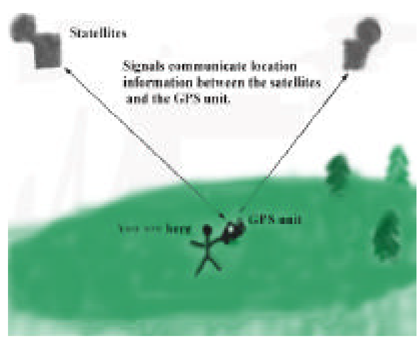
IN THIS ISSUE...

What Is GPS?

by Capt. John Ward, Ship's Master, M/V Kennicott, DOT&PF

Where Did It Come From?

The Department of Defense(DOD) began construction of its sophisticated satellite positioning system in the mid-1970s to allow military ships, aircraft, and ground vehicles to determine a location anywhere in the world. Although the designers meant it primarily for classified operation, they made provision for unclassified use by civilians. DOD assigned far less accuracy to the unclassified signals than the military counterparts. Such a reduction in accuracy seemed necessary for the unclassified signals, because an enemy could easily use the GPS broadcasts, destroying the military advantage afforded the U.S.



Remarkably, scientists and engineers working outside the armed forces devised ways to circumvent the purposeful degradation of the GPS signals, and ordinary citizens are now able to achieve much better results than the DOD expected.

How Does It Work?

GPS stands for *Global Positioning System.* A GPS sends signals to,

Transportation Equity Act for the 21st Century

by Stephen A. Moreno, Federal Highway Administration

On May 22, 1998 Congress passed the Transportation Equity Act for the 21st Century; President Clinton subsequently signed the bill. If you're reading this article for details of the TEA -21 legislation, stop now! The printed version is several hundred pages long. It will likely be several months before all the details and their respective impacts are known.

There are major aspects of the TEA-21 that are well understood. This is the largest bill in the history of the Federal Aid Highway program. The recently expired Intermodal Surface Transportation Efficiency Act (ISTEA) of 1992 provided an annual average of $18.1 billion to the nation; TEA -21 provides $25.9 billion per year. For Alaska, this is an increase from an average of $211 million to $308 million per year, including funding for Congressionally identified High Priority Projects.

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Ten Golden Town Bus Rules

by John Kern, Transit Manager, Capital Transit, Juneau City Borough

In May of 1996 I was chosen to participate in a study of model urban and regional bus systems in smaller European communities. Selected by a peer panel under the International Transit Studies Program, managed by the Eno Transportation Foundation, I participated along with 13 other transit professionals from across the United States. The ITSP is a component of the Transit Cooperative Research Program, which seeks to promote opportunities to gain global perspectives for improving transit in the United States. We traveled by bus from Zurich, Switzerland to Amsterdam, the Netherlands, visiting 17 operators in small communities in Switzerland, Germany, Austria, Belgium, and the Netherlands. The cities were small and little known: Frauenfeld, population 20,000; Ravensburg, population 45,000; Muenster, population 280,000. They all had a strong commitment to public transit and had achieved outstanding results through investment in a high level of bus service. Frauenfeld had ridership of 1.4 million in the past year; Ravensburg, 4.2 million; and; Muenster, 30 million.

In many of the cities we saw the same model for small city transit service at work. It is credited to Frauenfeld, Switzerland and Dornbirn, Austria. At the International Union of Public Transit Conference in Konstanz, Germany, Mr. R. Schulte, who had studied the successes in these communities, described the "Ten Golden Town Bus Rules."

1. Basic interval scheduling throughout, with no exceptions, a constant schedule. This means if your bus comes at 5 minutes after 7:00 a.m., it comes at 5 minutes after every hour that day, and on every day.
2. Direct routes. Routes are laid out from the passengers' perspectives; where do they come from, and where are they going?
3. "Rendezvous" connection(s). Routes meet at a central point for timed transfers. Passengers can access all routes including ferries, buses, trains, bicycles, even in small communities, from one central location. In most communities this was the town center or the regional rail station.
4. "Speeded up services," bus lanes, traffic signal preemption, and automated and prepaid fares. Even small communities are experimenting with "real time" traffic management and "smart card" fares. The implementation of technology seemed far ahead of anything we've seen in the United States.
5. Modern urban buses, low floors, wide doors, sometimes 3 doors. Again, an emphasis on the passenger in design.
6. Attractive stops. About four per mile with passenger shelter and schedule information.
7. Simple fares. One fare for all trips.
8. "Intensive and original marketing." $50,000 and more per year for marketing.
9. A "town bus center" located at the rendezvous stop providing customer service. Often rented space in a nearby store is staffed to provide fares and information.
10. A professional manager.

Many of these ideas are not new, but the combined effect of these design principles creates impressive results. There is an eleventh golden rule—privatization. In all the systems we visited which followed this model, services were contracted out to a private operator. The Transit Manager served as a broker, defining service levels and monitoring service quality.

Though privatization may give them some cost savings, these communities are all funding transit service at a high level. They are providing premium transit service to compact, densely populated communities. A primary difference from what we often see in the U.S. where managers find themselves struggling to provide a minimal level of service to a broad area of varying development and population densities. Since my experience in Europe, I have been working to incorporate the Ten Golden Town Bus Rules in Juneau. In 1997 we adopted a new Transit Development Plan incorporating many of these elements. During 1998 we will be purchasing four new low-floor buses. These Rules provide a concise statement of direction and a measure of quality for the design and implementation of transit service to small communities.•

Changes of TEA-21 to the FLHO IRR Program

by Marie Messing, T2 Advisory Board, Bureau of Indian Affairs Area Road Engineer

Funding has remained fairly stable on a national level with the new Transportation Equity Act for the 21st Century (TEA-21) with respect to the Federal Lands Highway Office (FLHO), Indian Reservation Roads (IRR) Program. There is one significant change to the IRR program from TEA-21: the funding distribution formula. TEA-21 specifies that a new formula will be established by the Secretary of the Interior under a negotiated rulemaking procedure with the implementation date October 1, 1999.

Presently, the Highway Trust Funds are distributed nationally for the IRR program based on a Relative Need Formula (RNF). The RNF is based on three factors, namely, the cost to improve, the vehicle miles traveled, and population of the community.

For Alaska, tribes complete applications for road projects, including a strip map and a Tribal resolution. Once approved, the project is included in the national IRR inventory. The national IRR mileage inventory then drives the RNF as follows:

50% Cost to Improve- This is the cost of construction for an area multiplied by the average inventory mileage.

30% Vehicle Miles Traveled- This is the inventory mileage multiplied by the average daily traffic (ADT).

20% Population- This is the reported population from the Indian Service Population and Labor Force Estimates published by the U.S. Department of the Interior, BIA.

Alaska tribes' RNF data, along with all "Lower 48" tribes RNF data, are placed into this formula and a percentage is determined for the BIA Juneau Area ("BIA Juneau Area" is the national program's term for Alaska). The BIA Juneau Area Branch of Roads then begins the planning, design, and construction of the roads in the inventory. Using this formula, it is possible for the percentage to change every day, depending on how the variables in the factors change.

For the new formula, TEA-21 states that the Secretary of the Interior will apply procedures under subchapter III of Chapter 5 of Title 5, Negotiated Rule Making Procedure. A committee will be established and will attempt to reach a consensus by October 1, 1999. TEA-21 also states the Secretary of the Interior will ensure that the membership of the committee includes only representatives of the Federal Government and of geographically diverse, small, medium, and large Indian tribes.•

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Many of the programs and concepts introduced in ISTEA remain: Transportation Enhancements, Congestion Management Air Quality, Statewide and Metropolitan Planning Factors. Elements of the program have been simplified to reduce the administrative burden and expedite project delivery.

Like ISTEA, the TEA-21 legislation provides a stable funding stream for six years. It supports flexibility in the application of the funds to meet local transportation needs. Eligible project costs include roadways, transit, ferries, bicycle and pedestrian facilities. Environmental feature eligibility has been expanded to further assure projects are a positive force in the community.

There are several special categories of funding available to Alaska. Alaska will receive new funding for the Alaska Railroad ($4.8M); 17 High Priority Projects ($11.4M); the Marine Highway System ($10M in FY's 1999-2003) and will share Federal Transit Administration funding with Hawaii ($14M in FY's 1999-2003).

A new feature of TEA-21 is guaranteed funding levels. Under this concept, the national level of available funding is tied to amounts received into the Highway Trust Fund. Previously, the funding available for transportation purposes was one of many competing priorities in the federal budget. Under the new budget rules, these highway guaranteed amounts can only be used to support Federal highway and safety programs.

Congressional focus on improving safety continues with the addition of incentive programs to reward states for participating in safety emphasis areas. These areas include promotion and enforcement of the 0.08 blood alcohol concentration standards for drunk driving and increased use of safety belts. These funds total approximately $2.7 billion over the life of TEA -21.

There are a host of other new provisions contained in the TEA 21 legislation. If you'd like to learn more, visit the Federal Highway Administration web site, www.fhwa.dot.gov. •

Flight 2000

by George Levassuer, T2 Advisory Board member, DOT&PF Southcentral District Manager

Exciting new technological advances are changing aviation as we know it. The ground-based aviation navigation systems are being replaced with satellite-based technology. In the next few years, the Federal Aviation Administration (FAA) is going to design and conduct a practical test of Global Positioning System (GPS) Data Link communications technology, navigation and surveillance, and conflict probe and safety alert systems. This test, called Flight 2000, centers on increasing flight safety while decreasing the cost of supporting a ground based navigation and communications infrastructure.

Beginning in 1999, the FAA will conduct a two-year evaluation of these new technologies in Alaska and Hawaii to help accelerate the pace of safety and efficiency improvements throughout the U.S. aviation system. The Department of Defense(DOD) is releasing its global digital terrain elevation database for use in the civilian sector. Combined with the advanced GPS navigation system, this will provide pilots with the tools needed to reduce accidents.

The goal of the "Ha-laska " (Hawaii-Alaska) project is to utilize technologies to support the concept of "free flight," which is a management concept to increase users' flexibility to plan flight routes and operate aircraft. This concept would let pilots fly whatever route and altitude is best for existing conditions. Alaska was chosen for its affordable fleet size, wide range of weather conditions and rugged terrain. The goal is to evaluate the safety benefits of providing weather displays, collision avoidance alerts, route tracking, and other safety information directly to the cockpit. About 1,400 commercial aircraft in Alaska will be equipped with these on-board avionics. This package will include electronics to determine route and altitude, a transmitter to relay the aircraft's position, a receiver to alert pilots to other aircraft in the vicinity, the DOD terrain information to warn pilots of approaching obstacles, and precision landing data from the GPS.•

GPS Takes Flight in Alaska's Skies

by Chris Janssen, Editor

Alaska Airlines, Frontier Airlines, Bellair Incorporated, and Wrights Air Service provided information for this article.

Major airlines as well as smaller commuter services throughout Alaska use Global Positioning System (GPS) technology every day as an aid to pilots and as part of navigation systems. The goal of every pilot is to bring the plane home safely every night, and GPS has proven itself to be an important part of helping a pilot do just that. The specific unit, and accuracy of the unit, as well as the extent to which the pilot is permitted to navigate by it, differs for each airline and is dependant upon its status as VFR (Visual Flight Rules, the pilot flies visually) or IFR (Instrument Flight Rules, the pilot uses instruments to navigate), and other navigation systems available.

Bellair Inc.'s Garmin GNC250XL unit displays course information.

The GPS holds preprogrammed information and prompts a pilot according to the information inputted. When the GPS is turned on, it displays the satellites that are within range as well as notifies the pilot of any messages. Before embarking on a flight, the pilot inputs the destination by using a set of preprogrammed codes. If the destination is Anaktuvuk Pass, the code is PAKP. After inputting the destination, the pilot inputs any waypoints needed to pass through for refueling or delivery. For a flight from Fairbanks to Anaktuvak Pass, the pilot may input a stop in Bettles for fuel. The GPS responds with a direct course, including bearings and distance, to Bettles and then follows the John River through the Brooks Range to the destination for the pilot to approve.

The GPS provides headings and course correction information throughout the flight, as well as the programmed information. Further information, including air speed, a moving map plotting the track of the trip, special airspace, waypoints, radio channel frequencies, pressure altitude, and nearest airports, can be reached at any time with the turn of a knob.

The GPS unit monitors the position of the plane via a track, which is displayed on the screen map. It alerts the pilot if the plane is within ten miles of special airspace, such military airspace, or if his altitude is 200 feet off the designated flight path.

The unit displays the moving map option. The plane follows the track of the plane as it flies. Waypoints are indicated on the track.

Even with GPS technology, a pilot flying VFR cannot fly blind through clouds or poor weather. The pilot must have a minimum of one mile visibility.A pilot flying IFR can go through clouds. He may use the GPS to monitor his accuracy by comparing the direct course and the gyro readings. Radio and radar communications with the air traffic controller insures that he is keeping the correct course.

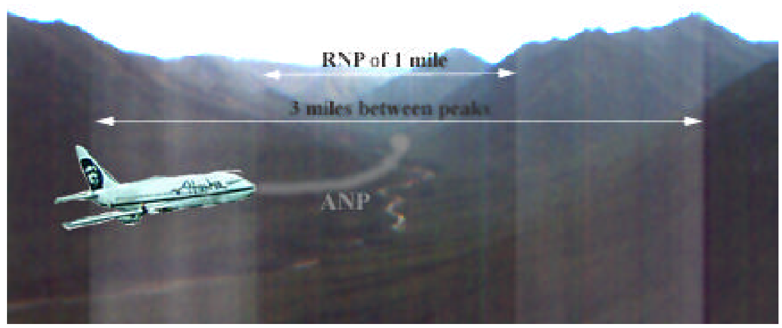
Generally, Frontier Airlines lands using an NDB(nondirectional beacon) approach, which limits the pilot to 800 feet AGL(Above Ground Level) at his Minimum Descent Altitude (MDA). GPS gives NDB approach accuracy by providing pilots with overlays for the approaches. Precision approaches reduce limits to 200 feet AGL.

GPS "makes navigation and fuel reserve calculation much easier," according to Wrights Air Service owner Bob Bursiel. Wrights has used GPS in its aircraft since it became available about six years ago. He says GPS allows the pilot to constantly see where he is headed, rather than only seeing what is right in front of him.

Other pilots agree with Bursiel. Director of Maintenance and Line Pilot at Bellair Inc., Eddy McKenney, said the GPS his aircrafts use is "very accurate and user-friendly." It is a great "aid to navigation and makes (flying) more efficient." He feels that even the hand-held GPS units many of Bellair's pilots keep with them are valuable to anyone in similar operations. "We use GPS everyday for VFR," says Frontier Airlines Director of Operations Bob Hajdukovich.

Some hold reservations about the use of GPS. GPS promotes safety by aiding pilots with navigation, but when used by every pilot, GPS use could become a safety issue. GPS gives "a direct line every time," says Bob Hajdukavich. He says when a pilot uses the GPS route to get from point A to destination B, he gets exactly the same airway that everyone else is using, thus causing a problem with possible collisions. Preventing collisions is a primary concern with approving the current GPS technology used in aircraft. Bellair Director of Operations and Line Pilot Karl Braun says he feels GPS is additional technology most pilots in similar operations don't need. "I like what it can do, but I think it does too much," he says. It provides a lot of nifty knobs, but the number of screens and optional uses can pose a safety risk if it draws the pilot's primary attention from looking out the window and flying the plane. "It keeps him looking inside, not outside where it (his attention) needs to be," he says.

Alaska Airlines uses GPS technology in the majority of its aircraft and plans to completely equip its fleet in the next few years. Alaska uses GPS along with the flight management computer and the inertial navigation system to operate terminal area and approach flight plans, as developed in-house. The new procedures, known as Required Navigation Performance (RNP), are being used in Juneau, Ketchikan, and Sitka. The procedures are a result of 10 years of work and five years in actual use. Alaska Airlines is one of the first to use it in approaches,



When used as part of the new procedures developed by Alaska Airlines, GPS technology allows the pilot to keep the ANP within the RNP.

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GPS at Work in Alaska

The Alaska Department of Transportation and Public Facilities (DOT&PF) and other agencies use Global Positioning System (GPS) technology in their work. The following information provides a few examples of how DOT&PF and the Mat-Su Borough use the technology.

DOT&PF Alaska Marine Highways

by Capt. John Ward, Ship's Master, M/V Kennicott, DOT&PF

The Alaska Marine Highway uses Global Positioning Systems aboard their ships.

In addition to having the ship's position readily available at all times, the type of GPS that the Alaska Marine Highway uses also enables the users to program waypoints and routes. A waypoint is predetermined position. A series of sequential waypoints makes up a route. Waypoints and routes allow the mate on watch to double check piloting accuracy to ensure the current course enables the ship to get to the next waypoint. The mate on watch must ensure that the data inputted is correct to ensure that the GPS provides the correct course.

Alaska's newest ferry, the Kennicott, uses GPS for navigation..

GPS has given us another tool to use in navigating. However, a fancy system like a GPS does not take the place of the good ol' common sense that a mariner must consistently use in order to be a prudent mariner.•

DOT&PF Preliminary Engineering-Environmental

by Greg Zimmerman, Environmental Analyst
DOT&PF Preliminary Engineering, Northern Region

The GPS units Northern Region Environmental uses are not surveyor grade, but they have proven adequate.One effective use is in developing Spill Prevention Contingency Control (SPCC) plans, which call for the longitude and latitude to be entered into the documents. Although the hand-held GPS units are only accurate within 100 feet, the degree of accuracy is much higher than what could be obtained by gleaning the information from a USGS map. The unit is also used to locate roadway, stream, or culvert crossings; to identify and locate unnamed, and at times unmapped, ponds and other water sources for water use permits, and to locate potential archeological sites, spill locations, and material sources. Using mile posts as markers can be extremely inaccurate due to changes in roadway alignment over time, but with GPS you are never in doubt as to where you are.

The prices of hand-held units make them very affordable. On the downside, the unit cannot be used as a hand-held in an aircraft or vehicle; however, we do have the option to place a separate antenna on our vehicles.

GPS comes in very handy in emergencies, such as locating a roadway problem or a highway accident where response time and accuracy could be critical. The Department is just beginning to learn where the applications of the device can be best applied. No doubt DOT&PF's use and dependency on the GPS will increase over time. •

DOT&PF Right of Way Location

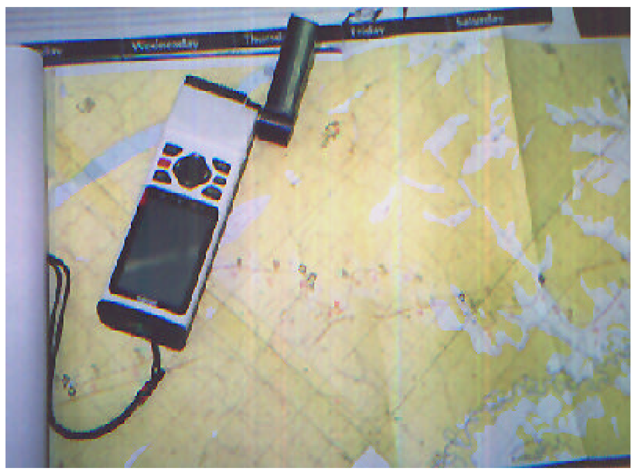
by Scott Sexton, Engineering Assistant, DOT&PF, Northern Region Locations

The Northern Region Location Section uses GPS in several different ways. One way is to locate existing monumentation, such as remote section corners. With the navigation capabilities of the GPS unit, we input the coordinates of the points we need to locate and let the GPS unit direct us to the monument.

Another use for hand-held units is to set remote photo panels. In the original placement of the photo panel, we get a navigated position of the panel. Then, we take the survey grade GPS units in to the remote point, and we can navigate to the panel as we do remote monuments. Survey grade units are accurate in DGPS(Differential GPS) mode to sub-centimeter levels.

Hand-held accuracy is only +/- 100 meters with selective availability(SA). SA affects the accuracy of GPS units. The Department of Defense degrades the satellite clocks randomly so a single unit cannot get a precise location. DGPS provides more accurate locations because it uses more than one unit. One unit is placed on a known point with precise latitude, longitude, and elevation. The unknown location is then referenced against the known location. Differential hand-held requires post-processing and is only accurate to +/- 3 meters. We use survey grade GPS units that give sub-centimeter accuracy over long distances. We use these units to establish project control both horizontally and vertically.

Vertical control is less accurate because we don't have enough gravity stations in Alaska to define the Geoid Model supplied by National Geological Survey (NGS). NGS uses gravity stations to determine the difference between the ellipsoid, or mathematical model the GPS references, and the Geoid, the equipotential surface of the earth. This project control is then used to close the conventional survey work and confirm the accuracy. We also use the survey grade units in control photo panels. •



Northern Region Environmental locates water sources with GPS and mapping.

Matanuska-Susitna Borough

by George Strother, Engineering Division Manager, Mat-Su Borough

The Matanuska-Susitna borough assessment department has used hand-held GPS units to locate driveways along existing roads to assist the Emergency 911 system locate driveways for those responding to emergency calls. Public Works has a small GPS that we have occasionally used to locate remote roads that may be shown incorrectly on the tax maps. Findings show that at times, GPS units have up to 1000 feet of difference. The hand-held systems are advertised to have a nominal +/- 100 meters. The borough has seen cases where the difference on entering and exiting a road exceeds 1000 feet because the selective availability exceeds the average error.

Mat-Su Borough has contracted out several GPS surveys. These include photopanel markings for the railroad route from Point MacKenzie to Houston, municipal entitlement surveys, and several other long distance surveys where survey quality, and differential corrected GPS survey instrument error become acceptable.•

DOT&PF Central Region Materials Section

by Dave Stanley, Engineering Geologist, DOT&PF Central Region Materials

Central Region Materials has been using GPS mapping grade receivers for about a year to locate test holes and test pits, map features, and locate falling weight deflectometer sites. We have rented Trimble ProXR receivers equipped with FM radios to acquire Coast Guard beacon data that allow real-time sub-meter accuracy.

Projects have included Sterling Highway MP 37-45 (200+ test holes/pits), Parks Highway MP 37-44 Phase I (about 25 test hole locations and reference points), Grey Cliffs Material Site at Seldovia (mapped site and air photo reference points), and Petersville Road falling weight deflectometer sites.

We are presently preparing a plan to develop a material site for the Sterling Highway MP 37-45 project. The development includes construction of a fish rearing habitat. The site is owned by Department of Natural Resources (DNR) and will be managed by Alaska Department of Fish & Game (ADF&G) after extraction of the borrow material. We located 104 test pits covering the site with GPS and are using the data to document the plan with GIS.

We rented a Trimble ProXR GPS receiver with a Laser Technology Impulse 200 laser rangefinder and a Laser Technology MapStar compass module for use on the Seward Highway MP 8-18 project. The setup allowed me to take offset readings to locations where thick trees or geographic constraints prevented direct GPS readings. I was able to locate about 25% or so of the sites that were masked from the satellites.

The process starts with taking a normal GPS reading: select the appropriate menu items in the data logger to set up a general data file and specific data point file. Take point data from the satellite. This normally requires a minimum of 120 readings at one second intervals; five minutes worth of readings generates better data. I compromise at about 3-4 minutes, depending on how good the satellite signal seems to be (monitor the signal attributes while taking data). After taking normal GPS data, start the electronic compass module by hitting the "on" button. Then start the laser rangefinder by hitting an unmarked button. Next, press a button on the data logger that says "offset." Press the unmarked button on the range finder to activate the laser. Sight on your target and press the same unmarked button to take the laser range. Within a second or two, the data logger receives the offset information. Turn off the compass module with the "off" button. The rangefinder has an automatic off feature. Then complete the 3-4 minutes worth of data collection required, stop recording data, and move on to the next location.

The Trimble GPS unit, antenna, compass module, rangefinder, data logger, and fanny pack with the FM receiver used by Dave Stanley.

The satellite broadcasts a signal, which is read by the GPS receiver and translated into location data, then stored in the data logger. The data logger records the location of the target, rather than the location of the receiver. The FM radio receiver collects satellite correction data broadcast by the US Coast Guard to eliminate built-in error in the satellite transmission. The laser hits the target and bounces back to the rangefinder. The rangefinder tells the data logger the distance to the target and the vertical angle from the rangefinder to the target. The compass module tells the data logger the true horizontal angle from north. The data logger processes all this information to arrive at the precise location of the target.

The GPS antenna, compass module, and rangefinder are attached to the top of a range pole. The data logger is attached to the side of the pole and with cables attached to a large fanny pack containing batteries and the FM radio receiver. I am very pleased with the system and have been surprised at how simple it is to use.

The readings have generally been in the 0.5-1.0 meter accuracy range. Some have gone a little over 1 meter. We repeated a few readings when they went to 20-30 meter accuracy (probably satellite problems). Some locations have been as good as +/- 0.2 meters. The goal is to obtain sub-meter accuracy.

Despite GPS's faults (*see article on page 13),* we are committed to using GPS to acquire our location data. Although our total project experience is limited, we're satisfied the method is sound and useful. We see value in combining GPS location data with GIS technology to provide a new generation of information-sharing tools for the Department. We intend to use GPS and take advantage of improvements in GPS technology as they are developed.•

Top of the World Transit Technology

by Ben Frantz, Director, North Slope Borough Department of Municipal Services

The Top of the World village of Barrow, Alaska has catapulted into the forefront of transit service technology. It got there through a cooperative effort among the North Slope Borough (NSB) Department of Municipal Services (DMS) Transit Division, Arctic Slope Consulting Group (ASCG), and Barrow Cable Television (BCTV) of the Arctic Slope Regional Corporation (ASRC).

A little over a year ago, Mike Sandstrom of ASCG, approached Ben Frantz, Director of NSB-DMS, about the benefits of a GPS tracking system for the community of Barrow.It didn't take long to realize the potential benefits the proposal held for Barrow. As an incentive, ASCG agreed to volunteer its time to the project if NSB purchased the equipment. At the time, the cost was estimated at $50,000. North Slope Borough Mayor Ben Nageak approved the project and its funding.

The system became available on BCTV Channel 57 during mid-winter of 1997. Several enhancements to improve the clarity and information have been made, including color-coding, and directional display of buses. Now, the routes and direction of the buses can be clearly understood at a glance.

The people of Barrow see a "real time" map on television showing the exact position of three separate buses on fixed routes. Global Positioning System (GPS) technology, a computer, and software interface receiver coupled to the local cable television service, provides this information. Bus patrons recognize and enjoy the benefit of knowing where the bus they need to ride is in relation to their location. The guesswork is taken out of intercepting the bus at the proper time.

Two main routes, Barrow and Browerville, run at 20 minute intervals. The only variations to the run are during peak hours, inclement weather, and when meetings are held at the Transit office for the drivers. The route to the old Naval Arctic Research Lab, which is the home of Ilisagvik College and the local village corporation, is not all on television map due to its distance out of town.

The delays and shutdowns are noted by the placement of the buses on the route maps. The system eliminates standing out in the wind wondering where the bus is and asking the question, "Am I too early, or has it passed me by?" It still doesn't answer the question, "Where are those polar bears?"

Hopefully, local businesses will see a benefit to having a television on their premises for their customers.

As with any new technology, problems arose. However, the problems weren't insurmountable. The manufacturer of the software for the interface with BCTV flew to Barrow and corrected most of its problems. NSB-DMS and ASCG are confident that this winter will be free of interruption due to service problems. During August 1998, NSB-DMS and ASCG began serious consideration of a "ticker bar" for public information on the channel with routes. The best news is that the installation cost for the first year amounted to $25,000. The remaining $25,000 of the initial $50,000 is committed to funding future program support.

Bus equipped with GPS technology at the North Slope Borough Transit station.

Barrow has a recorded ridership exceeding 1,500 patrons a day, despite its total population of less than 4,000. Considering that Barrow weather is primarily dark and wintry with the infamous arctic winds that, combined with the cold, often create minus 100 wind chill factors almost daily, and that upwards of 30 polar bears can be found in the vicinity at any given time, it is no surprise that Barrow is first in the nation for per capita ridership.

Despite the problems with transportation in the Arctic, patrons of the Top of the World have taken another step into the 21st century. They find themselves at the forefront of benefiting from technology for the new millennium. For most of those who call Barrow home, it is a pleasant switch from the tremendous struggle of getting services which others in the United States take for granted.•

GIS Finds a Following in Alaska

What is GIS?

Geographic Information System(GIS) is a computer-based tool which combines mapping and database information in one program. Spatial information from USGS surveys or independent GPS location surveys form the base of the map. Layers of information are then compiled and linked to specific locations on the map. Any information can be linked to a location, including population, maintenace facilities, airports, or environmental characteristics, without limit to the number of layers.

GIS provides general database operations to find information through queries and update information. Statistical data, as well as graphs, photos, and analyses, are accessable with GIS.

DOT&PF Northern Region

Information provided by Marty Shurr, Surveyor, PDC Engineering, DOT&PF

The concept of developing a Geographic Information System(GIS) for use in Alaska DOT&PF started with a few people interested in what was going on with GPS.These individuals formed a group known as GIS-T(see the following articles). Among those interested was Marty Shurr, whose knowledge of the system goes back to before GPS and GIS were a reality. Shurr used the Navy's satellite transit system while in the military, as a Field Artillery surveyor for the Marine Corps and a Geodetic and Topographic surveyor for the US Army. He started his involvement with GPS and GIS while working as a geodetic surveyor for the NASA Crustal Dynamics Project studying earthquake prediction. He came to work at DOT&PF in Southeast Region as a Right of Way Engineer, then as an Engineer Assistant in Northern Region.

Shurr became the "clearinghouse" for information on GPS and GIS since his arrival at DOT&PF in Fairbanks, until moving on to join the private sector.

According to Shurr, GIS is one way of informing people of a location or some piece of information when they have no idea what you are talking about. Geographers and environmental organizations have used the concept of GIS for years to demonstrate the terrain of an area, as well as the population and major products. GIS links information together. "You can put as many layers on top of it as you want," says Shurr. "You are only limited by your imagination and what you want to do with it." Some information about Alaska is already available on the Web since many environmental organizations and government agencies used GIS to create maps for tracking forest fires, development, mining, and oil drilling.

Although Northern Region has not implemented GIS on projects, other regions have. As a whole, DOT&PF is deciding what software to use for inputting and accessing its GIS database. The plan for GIS in the Department is for Headquarters to have a server with the main database. ArcInfo or AutoCad Map would be the primary software for creating and supporting the system. Each region would have ArcView or a similar program for accessing the server information and local work. In the future, every desktop will have access to the information with a browser like ArcExplorer.

The idea is for the user to use a browser to find a map of the area he or she wants to know more about. Then click on any point on the map and instantly get information about traffic data, wetland info, materials sources, project histories, maintenance costs, and environmental data. Allowing each user to access the information directly from their desk also improves efficiency. The user finds the information needed in few minutes rather than the hours it could have taken to assemble the information from the different departments or sections that control the information. Shurr says, "Any bit of information can be referenced spatially. Every section within DOT &PF can make use of it."•

DOT&PF Central Region

by John Fritz, DOT&PF Central Region Design

The Highway Analysis System (HAS), was developed in the early 1980s as a mainframe database of road attributes. It was intended to be a GIS type application, but the spatial aspect was never developed. The mainframe databases are important stores of data, and must be integrated into current efforts. DOT&PF Headquarters mapping group advocated GIS tools early on, and used them within their group. No department-wide GIS efforts were initiated until 1998.

Material site management responsibilities made me realize there had to be a better way to integrate files and spatial locations, and do location queries. Locating information involves familiarity with filing systems, knowledge of site locations, access to geotechnical and other. files spread throughout numerous sites, including satellite office locations all over the state. GIS data integration demonstrates a cost savings in both the short run and the long run. The system removes the need to go out and locate the data.

Central Region's Right of Way Engineering Supervisor Jim Sharp also recognized value in having databases of information for parcels, right of way widths—in general, a "title plant" of land interests held by Department of Transportation & Public Facilities. Materials Engineer Newt Bingham also recognized the value of recording testhole locations with GIS. Currently, consultants must locate unrecorded testholes each time the holes need to be identified. Accurate latitude and longitude will remove the expense of locating the holes twice. Centerline and offset data for roadways are often revised as the alignment of projects changes with new construction. GIS displays geographically correct road alignments as well as other information associated with the roadways. Material sites, project limits, guardrail conditions, signposts, pavement conditions, and the location of other pertinent sites, such as airports, public facilities, and maintenance stations, are linked to the roadway data.

Early GIS efforts must encourage the development of more databases organized around spatial parameters, delineate stewardship responsibilities of those datasets (for upkeep and editing), recommend standards for data storage, and establish and maintain data procedures.

The GIS-T Peer Group, made up of several DOT&PF employees interested in planning and implementation of department-wide GIS capabilities, expects to have a report with recommendations on implementation for DOT&PFs Commissioner this fall. The focus is to assure that the independent GIS projects currently underway are compatible. Product implementation does not have to be vendor-specific since all the top GIS tools use compatible formats or translation utilities, and participate in the Open GIS forum. The number of different GIS products used in the department depends on the preferences of each work unit. The goal is for GIS-T to be a distributed technology, available to users at each workstation, just as word processing tools and spreadsheets are easily accessible. •

GIS map of Anchorage surface roads. Each description linked to further information about the project.

DOT&PF Statewide Mapping

by Kerry Kirkpatrick, DOT&PF Headquarters, Statewide Mapping

The Statewide Mapping Section is Statewide Planning's full service mapping/GIS group with three NT workstations that run GIS, mapping, and graphic software. This software includes ArcInfo, Arcview, ArcCad, AutoCad, Map Objects and Micrografx Designer. A complete darkroom is used for duplication and enlargement capabilities of line work and aerial imagery, plate making, color proof production, film processing, and various other darkroom activities. We also have a large format Photoplotter that plots directly to film. Using this method we are able to make our own color separates of maps that we are going to publish, with no loss of quality and perfect line resolution.

Statewide Mapping has had an automated mapping and GIS system since the mid 1980s. However, the Department has notbeen able to fully utilize GIS until the 1990s. The lack of current digital controlled bases for the state causes a problem since controlled bases form the foundation of any GIS. In the past, we lobbied the US Geological Survey (USGS) to map Alaska to the extent that it has the rest of the US. Every state and federal agency that had an interest in mapping supported the effort. Despite some mixed results, it has brought a lot of attention to the lack of current controlled mapping in Alaska.

Recently, through a federal program, the USGS has started to look at this problem. They are currently in the process of updating the Hydrography on the 1:63360 quadrangle, which dates back to the 1940s. There is also a lack of mapping for the transportation infrastructure in the state.

Statewide Mapping recognized the problem and has been working with other agencies and USGS to develop current coverage of the transportation network through cooperative agreements. Last year, we developed a cooperative pilot project with the Traffic Data section to collect road centerline data in Southeast Alaska using a Differential Global Positioning System (DGPS) mounted on a vehicle, and to update the highway inventory database. We acquired Trimble DGPS and trained a crew on the methods and procedures for collecting centerline data. After collecting the data, we post-process it, clean it up, and attribute the file. Our goal is to collect all the roads in the state. The USGS anticipates updating their quads with the data from the project.

We utilize GIS in one form or another on various projects. We are currently testing a way to tie to the HAS. Our focus has been collecting and developing a transportation base for the state. We are also working and experimenting with ways to bring GIS to desktops and to make our digital data available to everyone.•

DOT&PF Southeast Right of Way

by Garrith McLean, DOT&PF SE Right of Way

Southeast Region has been using GIS on projects for the last two years. ArcView is installed in Right of Way, Materials, and Utilities. Materials has used its copy for one project, Pavement Management System. Right of Way has used ArcView on about two dozen projects in the last two years. Many in the Region have access to the information, which is stored in Juneau, through ArcExplorer. Those already using AutoCad for design drawings and aerial photography are using AutoCAD instead of ArcView.

A new server for storing the USGS quad maps and other aerial photography, and survey data is being purchased.

I am the Southeast Region representative for GIS users. I have found ArcView to be a valuable tool in my work here the last two years. I've been able to produce maps for the Juneau Access project, various Right of Way projects, litigation displays, design, and planning maps. •

Matanuska-Susitna Borough

by George Strother, Engineering Division Manager, Mat-Su Borough

Nine years ago, assessment mapping was hand drawn on mylars. Since then, it has been converted either by scanning or entering plat information into a multi-layered GIS. The borough tax maps have been slowly transferred into a GIS/LIS information system on AutoCAD and ArcInfo formats. The computerized tax maps have many layers including topo for the core area, plat information, road maintenance information, and comments.

The maps are being integrated into the Assessment database, so types of use and occupancies can be plotted out and queried for planning and management purposes. Our GIS was used extensively during the Miller's Reach fire to plot out the extent of the fore and the fire fighting unit boundaries, in order to keep the fire fighting management up to date with good graphical mapping.

The Borough's GIS section currently employs two full time staff and two interns.•

GPS Has Its Drawbacks, Too

Dave Stanley from DOT&PF's Central Region Materials provided this information on drawbacks to using GPS.

For all the positive aspects of GPS, there are some downsides:

1. Some Project Managers may consider the purchase or rental of equipment too expensive. Purchase price of the units we have been using is in the $12,000-$15,000 range. Rental is about $4,000 for typical large highway or airport investigations.

2. GPS doesn't always work. Beyond 200-300 miles of the southern and southeastern coast, cumbersome and/or expensive post-processing methods and project specific ground stations must be used. GPS is terrain and vegetation limited. The farther north you travel, the more difficult it is to acquire satellites. If your location is in deep valleys or behind other terrain obstructions, your receiver may be unable to see the satellites. *(See Stanley's story on page 8 for more on bypassing this problem.)*

3. GPS has to be scheduled carefully. It is generally not practical to use the equipment while you are engaged in other duties.

4. Data has to be mildly massaged to convert latitude/longitude to project coordinates. •

continued from pg 5

departures, and the route phase. Vice President of Flight Operations Michel Swanigan says the system takes the distance between mountain peaks and asks "what is the biggest navigation error we can have and still be safe?" If two mountains are three miles apart, the computer may decide that the aircraft can safely fly ½ mile to either side of the center. The one mile of leeway accounts for the RNP. In order for the aircraft to remain in the RNP, four independent computers aboard the plane, including two using satellite positioning, ascertain the position of the plane and compare the positions. The difference between the positions accounts for the Actual Navigation Performance (ANP). If the ANP is within the RNP tolerance, the pilot is allowed to continue on the approach.

Alaska Airlines hasn't stopped there. They are using two new RNP arrivals and departures into Juneau. Pilots can now go south out of the airport through the Gastineau Channel. According to Bill Zizka, project engineer for Alaska Airlines, using GPS for approaches and departures, as well as adding the new route, improves the safety of flying into and out of Juneau and improves accessibility, despite the often poor weather conditions.

Cost of installing GPS units is an issue for some organizations. Frontier's aircraft are now equipped with the Apollo 2001, Garmin 100, or Kincarle 190B. The Kalin GPS unit installed in some Frontier aircraft costs about $12,000. Bob Hajdukavich estimates the current price of $20,000 for the most advanced navigation system will drop by half in a year or so because of the incredible competition in the industry. The system installed in the aircraft at Bellair is the Garmin GNC 250 XL. It includes the GPS system as well as a COM radio. The actual device fits securely in the control panel and includes an antenna in the roof of the plane. The unit cost is about $4,000 fully installed in the plane.

Alaska Airlines is working with the Federal Aviation Administration, other airlines, airports around the country, and manufacturers to develop LAAS (Local Area Augmentation System) and WAAS (Wide Area Augmentation System). LAAS and WAAS are augmented forms of GPS that combine satellites and ground stations to give higher integrity. The LAAS system is made up of three GPS receivers placed on a box at a surveyed spot at the end of the runway. A correction factor is programmed into the GPS according to the determined position of the box. The GPS receives a signal from the WAAS system located in the wing tips and nose of a landing aircraft.

The industry funds the work to develop the new technology through airline industry pairs at several airports around the nation. Testing on the new equipment should begin in the third quarter of 1999 or the beginning of 2000. Part of the requirements imposed on the development process is that the technology developed must affect the larger aviation community. Zizka says it will become "pretty much standard equipment," for the industry and will soon become affordable and accessible to the smaller commercial organizations and the private pilots. Hajdukavich says Frontier is looking to the horizon and the use of LAAS and WAAS.

Alaska Airlines anticipates upgrading all its systems to WAAS when the technology is approved. Zizka estimates the upgrade will cost about $10,000 to $12,000 per plane.•

Date	Event	Sponsor/Contact	Location
October 20-22 December 1-3	NHI #14205 Documenting NEPA & Transportation Decision Making	Alaska T2 Center, Sharon McLeod-Everette (907) 451-5323	Anchorage, Alaska Holiday Inn Fairbanks, Alaska Westmark Fairbanks
October 26-30	Traffic Engineering Short Course	Maryland T2 Center (301) 405-2009	College Park, Maryland Best Western Maryland Inn
October 26-27 October 29-30 November 2-3	FHWA Demo Project #115 Probabilistic Life Cycle Cost	Alaska T2 Center, Sharon McLeod-Everette (907) 451-5323	Fairbanks, Alaska Anchorage, Alaska Juneau, Alaska
November 4-6	United States Hot Mix Asphalt Conference	NAPA (301) 731-4621	Portland, Oregon Portland Hilton
November 6-10	AASHTO Annual Meeting	Hannah Whitney (202) 484-2902	Boston, Massachusetts
November 16 November 18	Practical Approaches for Effective Erosion & Sediment Control	IECA, Tracy Zuschlag 1-800-455-4322, or Alaska T2 Center, Sharon McLeod-Everette (907) 451-5323	Fairbanks, Alaska Last Frontier Club Anchorage, Alaska Anchorage Hilton
November 17-20	NHI #13108 Techniques for Pavement Rehabilitation	Alaska T2 Center, Sharon McLeod-Everette (907) 451-5323	Anchorage, Alaska Regal Alaskan Hotel
November 17 November 19	How to Control Erosion & Establish Vegetation on Steep Slopes	IECA, Tracy Zuschlag 1-800-455-4322, or Alaska T2 Center, Sharon McLeod-Everette (907) 451-5323	Fairbanks, Alaska Last Frontier Club Anchorage, Alaska Anchorage Hilton
November 18 November 20	Biotechnical Erosion Control for Slopes and Streambanks	IECA, Tracy Zuschlag 1-800-455-4322, or Alaska T2 Center, Sharon McLeod-Everette (907) 451-5323	Fairbanks, Alaska Last Frontier Club Anchorage, Alaska Anchorage Hilton
December 7-8	Statewide Transportation Planning Conference	Alaska DOT&PF Statewide Planning, Marti Dilley (907) 465-6988	Anchorage, Alaska Sheraton Hotel
March 2-4	NHI #13027 Urban Drainage Design	Alaska T2 Center, Sharon McLeod-Everette (907) 451-5323	Anchorage, Alaska

Meetings Around Alaska

Society	Chapter	Meeting Days	Location
ASCE	Anchorage Fairbanks Juneau	Monthly, 3rd Tues., noon Monthly, 3rd Wed., noon Monthly, 2nd Wed., noon*	Northern Lights Inn Captain Bartlett Inn Westmark Hotel *except June-Aug.
ASPE	Anchorage Fairbanks Juneau	Monthly, 2nd Thurs., noon Monthly, 1st Fri., noon Monthly, 2nd Wed., noon*	West Coast International Inn Captain Bartlett Inn Westmark Juneau Hotel *except June-Aug.
ASPLS	Anchorage Fairbanks Mat-Su Valley	Monthly, 3rd Tuesday., noon Monthly, 4th Fri., noon Monthly, last Wed., noon	Executive Cafeteria, Federal Building Ethel's Sunset Inn Windbreak Cafe; George Strother, 745-9810
ITE	Anchorage	Monthly, 4th Thurs., noon	Sourdough Mining Company
IRWA	Sourdoughs Ch. 49 Arctic Trails Ch. 71 Totem Ch. 59	Monthly, 3rd Thurs., noon** Monthly, 2nd Thurs., noon** Monthly, 1st Wed., noon	West Coast International Inn **except July & Dec. Last Frontier Club Mike's Place, Douglas
ICBO	Northern Chapter	Monthly, 1st Wed., noon	Zach's, Sophie Station
AWRA	Northern Region	Monthly, 3rd Wed., noon, Brown Bag Lunch	Rm 531 Duckering Bldg., University of Alaska Fairbanks, Larry Hinzman, 474-7331
PE in Government	Anchorage	Monthly, last Fri., 7am	Elmer's Restaurant

Digital Orthophotography

Orthophotos are aerial photographs that have been rectified using ground control points and digital elevation models. The resulting photographs are geometrically equivalent to conventional planimetric maps, such as United States Geological Survey (USGS) quadrangles. Historically, analog processes have allowed the creation of digital, or computerized, orthophotos.

Digital orthophotos are easily integrated into Geographic Information Systems (GIS) and are rapidly becoming the standard basemaps for a number of GIS applications. Digital orthophotos provide users with the ability to do heads-up digitizing. Heads-up or on-screen, digitizing provides a cost-effective means of capturing planimetric features, such as roads, land use/cover and hydrography, without having to use more expensive stereoplotting devices or less accurate optical transfer devices. Digital orthophotos also significantly increase the interpretability of standard GIS vector line work. The ability to display a photographic-quality image as a background to vector data makes it easier for the lay-person to understand complex GIS displays, and reduces the need for cartographic symbolization.

Digital orthophoto quarter quadrangles (DOQQ) for Florida were first created from the 1994-1995 National Aerial Photography Program (NAPP) overflight. The USGS, the five water management districts, and the Florida Department of Environmental Protection (FDEP) cooperatively funded the NAPP and digital orthophoto projects. The DOQQs have the following characteristics:

Resolution: 1 meter

Projection: Universal Transverse Mercator, NAD83/90

Accuracy: Meet or exceed National Map Accuracy Standards for 1:12,000 scale maps

Digital Files: Three bands, red, blue, and green create a color infrared image. Each 3.75 minute DOQQ requires approximately 156 megabytes of data storage.

Ordering: The data are available either from the USGS (1-800-USA-MAPS) or the Florida Resources and Environmental Analysis Center (1-850-644-5886).

Planning is currently underway by the FDEP, USGS, and the water management districts to obtain new NAPP photography in 1999-2000 and update Florida's DOQQs. For more information, and to learn how to apply the technology to your program, contact Steve Dicks, Southwest Florida Water Management District, at (352) 796-7211.

Adapted by Florida T2 Center from Technology Transfer Quarterly, May 1995, Florida Technology Transfer Center.•

HITEC and Center for Transportation Research Sign MOU to Advance Innovation, Intelligent Transportation

The Highway Innovative Technology Evaluation Center (HITEC), a service center of the Civil Engineering Research Foundation (CERF) has signed a Memorandum of Understanding (MOU) with the Center for Transportation Research (CTR) of Virginia Tech. The MOU combines HITEC's objective, technical innovation evaluation services, with the intelligent transportation technology research capabilities of CTR to benefit the highway community.

CTR is dedicated to research, education, and outreach in Intelligent Transportation Systems (ITS) and other advanced transportation technologies. HITEC is an independent Innovation Center that works to expedite the acceptance of highway innovations into the design and construction marketplace.

The partnership envisioned under this MOU is one where HITEC's nationally recognized process for evaluating innovative technology would utilize the resources and testing facilities at CTR to conduct such evaluations. In addition, the MOU encourages HITEC and CTR to seek opportunities to promote their mutual programs and engage in joint conferences, workshops, and other events where they can publicize their complementary services and seek support from highway industry sectors.

For further information concerning the CERF-CTR memorandum or HITEC, please contact Peter Kissinger at 202-842-0555 or hitec@cerf.org.•

Metric Rebar

The use of soft-metricated reinforcing steel as the metric standard for rebar in the U.S. has been officially adopted. Specifications for soft-metric rebar are now available from the American Society for Testing and Materials (ASTM) and the American Association of State Highway & Transportation Officials (AASHTO). After polling rebar producer members, Victor Walther Jr., Concrete Reinforcing Steel Institute (CRSI) president, said the new soft-metricated rebar was made available by various producers beginning in December, and that the majority of the producers will have such products available during the first quarter of 1997.

"AASHTO has recommended and approved the use of soft-metric in all highway construction," Walter told ROAD & BRIDGES. "ASTM [also] has developed the soft-metric specifications as the current rebar spec." With the use of soft-metricated rebar, the inch-pound bar measurements will eventually become nonexistent.

The initial conversion method for reinforcing steel was hard metrication, which reduced the existing 11 inch-pound bar sizes. "Everyone thought that it would be a nice opportunity to change the old existing system, inch-pounds, to a hard metric system, which eliminated three of the bars," Walther said.

In 1988, the Omnibus Trade and Competitiveness Act passed, stating that in order to get federal funding for federal projects, metric products must be used. Because using the hard-metric rebar sizes was not required in the private-sector construction market, which represented 70% of the total construction market, this market stayed with the inch-pound bar sizes. With 30% of the federally funded market using the newly specified eight bar sizes, and the remaining 70% of the market staying with the 11 inch-bar sizes, a new problem was created—19 bar sizes.

The reinforcing steel industry conducted an in-depth analysis of the economic impact on the construction industry of having to carry two complete inventory systems. The analysis determined that this dual inventory system would cost the end consumer $300 million per year.

Their solution to the problem, according to Walther, was to implement soft-metricated reinforcing steel. By using this approach to metrication, the existing 11 inch-pound sizes physically remain unchanged. A necessary change would then be to develop new soft-metric names for those existing rebars, giving the metric equivalent to the old bar sizes. The inch-pound size is the name of the bar expressed in eighths of an inch in diameter. In the metric system, the bars are renamed, using millimeters. A #10 metric bar is 10 mm in diameter. Thus, a #6 inch-pound bar size is now a #19 soft-metricated bar size.

"In essence, we're staying with the 11 bar sizes that we always had, which are still being produced, but they have a new name," Walther said. "We've eliminated the need for the eight new hard-metric sizes, they don't exist anymore, so there's not the increase of $300 million per year to the industry, and ultimately, to the consumer." *Adapted with permission from Jeanne Anderson article in ROADS & BRIDGES, 1/97.*•

Inch-Pound Bar Size*	#3	#4	#5	#6	#7	#8	#9	#10	#11	#14	#18
Metric Bar Size**	#10	#13	#16	#19	#22	#25	#29	#32	#36	#43	#57

*nominal diameter expressed in eighths of an inch **nominal diameter expressed in millimeters

The GPS Week Rollover

GPS System Time will roll over at midnight August 21-22 1999, 132 days before the year 2000. On August 22 1999, unless repaired, many GPS receivers will claim that it is 6 January 1980. August 23 will become January 7, and so on. Accuracy of navigation may also be severely affected. It appears that GPS broadcasts do contain sufficient data to ensure that navigation need not be affected by rollover in 1999. The firmware has not been proven to handle the rollovers in stride, so some receivers may claim wrong locations in addition to incorrect dates. Some manufacturers have already solved the problem.

Precise rollover date is computed: The timescale origin (time zero) of GPS System Time, 00:00:00 UTC 6 January 1980, is Jillian Day 2,444,244.5000. A GPS Cycle is 1,024 weeks, or 7,168 days. Therefore, the first GPS rollover will occur at Julian Day (2444244.5 + 7168) = 2,451,412.5, which is 00:00:00 UTYC 22 August 1999 AD. This is midnight between Saturday night, the 21st of August, and Sunday morning, the 22nd of August 1999.

Section 3.3.4(b) (page 33) of the *ICD-GPS-200, Revision C* (25 September 1997 issue) states that the GPS Week count starts at midnight January 5-6, 1980 UTC, and that the GPS Week field is modulo 1024. This means that the week count will rollover 7168/365.25 = 19.6249 years from then, or in 1980+19.25= 1999.638 (August 21, 1999), only a year from now.

In the July 1993 update of *ISD-GPS-200*, a note was added (also on page 34) saying that the week number will roll over, and that users must account for this, but no way to accomplish this is mentioned. I take this note as further evidence that there is no way to tell, given only the signal-in-space definition, as of July 1993.

Section 2.3.5 (pages 18-19) of the GPS SPS Signal Specification, 2nd Edition, issued on June 2, 1995, repeats the words and warnings of *ICD-GPS-200*. The GPS SPS Signal Specification may be obtained from the Web as an Adobe Acrobat (.pdf) document, at the U.S. Coast Guard's site at http://www.navcen.uscg.mil/gps/geninfo/gpsdocuments/sigspec/d.

The firmware in all affected (mostly older) receivers will have to be replaced, including the PROMs(Programmable Read Only Memory). Some PROMs are socketed, while some are soldered. As a technical matter, the solution is quite simple. It's the logistics that will take some effort.

Users cannot test a GPS receiver for this problem without a GPS simulator. Users are encouraged to contact their receiver manufacturer to determine if their receiver will be affected, in particular if a failure of navigation could put lives or property at risk.

Reprinted with permission from the U.S. Coast Guard Navigation Center Web site, http://www.navcenn.uscg.mil/gps/geninfo/y2k/gpsweek.htm.•

Internet Update

Did you know... there is a Web site, www.ltap.org, which allows you to search for transportation related newsletter articles from all of the nation's LTAP T2 Centers? The site is under construction so those interested should check in regularly to see additions and changes, but in the meantime, newsletters from 1992 through 1997 are available. You can search by key word or by state, and you can use other links. Those links include: Innovative Ideas, Other LTAP Centers, Other Transportation Sites, and USDOT.

Interested in knowing more about TEA 21? Visit the FHWA Web site at http://fhwa.gov.tea21/2400enr.htm to view the bill approved by Congress.

For more information on GPS, visit the U.S. Coast Guard Navigation Center Web site. The site provides information on GPS technology and updates the latest news on the system at www.navcen.uscg.mil/.

Visit the Alaska Land Surveyor's Web site for information on the organization and how it is using GPS and GIS technology at www.ptialaska.net/~aspls.

GeoNorth provides GIS information on Anchorage and other downloadable information at www.geonorth.com/index.cfm.•

Planning Uses DGPS to Establish GIS BASE

by Jack Stickel, DOT&PF Headquarters Statewide Planning

Statewide Planning, Department of Transportation and Public Facilities (DOT&PF), embarked on a multi-year program to inventory most public roads, including local roads, in Alaska. The inventory has two phases. First, an inventory of centerline mileage and features will be used to update the route general logs in the DOT&PF Highway Analysis System (HAS). The last general inventory was in the mid-1980s, and except for a few revisions, there have been no efforts to do a comprehensive update. Specific elements of this update effort include centerline mileage and milepoints for bridge decking begin and end, railroads, overpasses, businesses, and other major points of interest. Existing HAS roads are adjusted for both length and features using software developed for this annual work program project.

The second phase of the inventory program is to collect of road centerline and bridge decking coordinates using Differential Global Positioning System (DGPS). Statewide Planning selected the Trimble GPS Pathfinder Pro XR Mapping System with ASPEN field software for the DGPS data collection. The package also included Trimble's Microsoft Windows-based Pathfinder Office software for data processing, analysis, and Geographic Information System (GIS) export. We used both Windows 3.1 and Windows 95 operating systems for the ASPEN-based GPS data collection and management software. The Pro XR integrates a beacon differential receiver and a satellite differential receiver into a single unit, allowing real-time or post-processed differential correction. The DGPS collection equipment is composed of the DGPS antenna, magnetic vehicle antenna mount, an 8 channel DGPS receiver, the associated cables and connectors, a soft hip pack for portable operations, a battery charger, and an IBM laptop computer (supplied by DOT&PF). The portable feature offers the capability to collect data over bike paths, trails, and remote locations where vehicle data collection is impossible.

The Pro XR provides real-time sub-meter accuracy if data is collected at a position for more than 180 seconds. Statewide Planning collected the centerline coordinates kinematically, with vehicle speeds varying from low (less than 5 mph) for bridge coordinates to normal highway speeds (35 –50 mph) on relatively straight roadways. Since the DGPS coordinates are point-to-point line segments, slower speeds on meandering roadways provide a more accurate data capture. Data accuracy is generally better than 10 meters.

Statewide Planning uses DGPS base station correction data from the United States Coast Guard, United States Forest Service, and the University of Alaska. Much of the data is available via the Internet. Private correction data is also available. AutoCad, Pathfinder Office, or ArcInfo software is used to break line segments at intersections, smooth segments, or remove wandering points. The centerline files are then attributed with route names and DOT&PF route numbers. These files are converted in shape files or route coverages so that the files can be viewed, queried, and linked to various databases for displaying information using a GIS. Mapping staff is in the preliminary stages of developing a linkage with the HAS.

A two-person team performs field data collection. The team generally drives each road at least twice (more if in a congested area) to collect both the centerline features and DGPS coordinates. Statewide Planning inventoried most of Southeast Alaska in the summer of 1997. The new road inventories have been added to the HAS and the centerline coordinate files have been edited using the steps discussed. This summer a two-person team is collecting both Phase 1 and 2 inventories in Northern Region as well as Kodiak. A data collection team will visit Nome, Cordova, and Yakutat this fall. We anticipate loading the data to the HAS and correcting the DGPS data during the fall and winter. A second data collection team is being established so that Central Region can be completed in 1999. An additional Trimble Pro XR DGPS unit and associated software will be employed in Anchorage during August. This second Pro XR will also give us the option of setting one of the systems as a base station for collecting correction data. This would allow data collection in areas not served by a base station, particularly in rural communities not connected to the Alaskan road network.

The United States Geological Survey's Rocky Mountain Mapping Center is looking into this project as a possible solution and method for updating and revising the Alaska series of quads transportation layers.•

_____**Progress Report on Maintenance and Operations Personnel,** TRC #486, Transportation Research Board/National Research Council

_____ **Road Weather Information System Decision Support,** Research Report 1380-3F, Center for Transportation Research Bureau of Engineering Research

_____ **Bibliography on Cold Regions Science and Technology,** Volume 51, Part 1, Cold Regions Research and Engineering Laboratory

_____ **Field Evaluation of Engineered Culverts,** Report # INE/TRC 97.02, Transportation Research Center, University of Alaska Fairbanks

_____ **A Test Method for Identifying Moisture Susceptible Asphalt Concrete Mixes,** Research Report 1455-2F, The Center for Highway Materials Research-The University of Texas at El Paso

_____ **Contract Administrative Core Curriculum, Participant's Manual and Reference Guide,** FHWA 1997, US Department of Transportation, Federal Highway Administration

_____ **Estimated Construction Period Impact of Widening U.S. 59 in Houston, Texas,** Research Report 1260-3, Texas Transportation Institute

_____ **Bridge Rating Using KDOT FWD and the Related Methodologies,** Final Report K-Tran: Ksu-96-1, Kansas DOT, Kansas State University

_____ **Effects of Segregation on Mix Properties of Hot Mix Asphalt,** Final Report K-Tran: KU-96-6, Kansas DOT, Kansas State University

_____ **Performance of KDOT Temporary Erosion Control Measures,** Final Report K-Tran: KU-97-2, Kansas DOT, Kansas State University

_____ **KDOT Temporary Erosion-Control Manual,** Kansas DOT

_____ **High Performance Concrete Pavement,** Construction Report FHWA-KS-98/2, Kansas DOT

_____ **Video Inspection of Highway Edgedrain Systems,** FHWA-SA-98-044, USDOT, Federal Highway Administration

_____ **Electronic Lien and Titling,** Research Report 3913-S, Texas Transportation Institute

_____ **Work Zone-Related Traffic Legislation: A Review of National Practices and Effectiveness,** Research Report 1720-1, Texas Transportation Institute

_____ **Innovative Materials and Design of Soundwalls,** Research Report 2968-S, Texas Transportation Institute

_____ **Service Life of Drainage Pipe,** NCHRP synthesis 254, Transportation Research Board - National Research Council

New Publications and Videos

_____ **Briefs of Research Problem Statements,** Program # FY 1999, NCHRP

_____ **Catalog of 1998 Practical Papers, Design and Construction of Transportation Facilities,** Catalog # 1998, Transportation Research Board

_____ **Transportation Planning and ITS: Putting the Pieces Together,** FHWA-PD-98-026, US DOT Federal Highway Administration

_____ **Impacts on State and Local Agencies for Maintaining Traffic Signs Within Minimum Retroreflectivity Guidelines,** FHWA-RD-97-053, US DOT Federal Highway Administration

_____ **Maintenance Issues and Alternate Corrosion Protection Methods for Exposed Bridge Steel,** NCHRP Synthesis 257, Transportation Research Board - National Research Council

_____ **Social, Economic, and Environmental Effects of Elevated, Depressed, and At-Grade Level Free ways in Texas,** Research report 1327-6F, Texas Transportation Institute

_____ **Swedish National Road and Transport Research Institute,** VTI sartryck 275

_____ **Assessment of Existing and Alternative Traffic Control Devices in Texas Border Areas,** Research Report 1274-2, Texas Transportation Institute

_____ **Thin-Surfaced Pavements,** NCHRP Synthesis 260, Transportation Research Board

_____ **International Transportation Education and Training,** Conference Proceedings 17, TRB-NRC

_____**Statewide Research,** 1991 Final Report, Alaska DOT&PF Research

_____ **Use of Alaskan Coal Ash in Construction Part 1, Use of Alaskan Fly Ash in Concrete,** INE/TRC 95.1, Transportation Research Center, University of Alaska Fairbanks

_____ **Use of Alaskan Coal Ash in Construction Part 2, Re-Utilization of Coal Fly Ash as a Road Base Material,** INE/TRC 95.2, Transportation Research Center, University of Alaska Fairbanks

_____ **Fatigue-Resistant Design of Cantilevered Signal, Sign, and Light Supports,** NCHRP Report 412, Transportation Research Board, NRC

_____**Quality Control and Acceptance of Superpave-Designed Hot Mix Asphalt,** NCHRP Report 409, Transportation Research Board, NRC

_____ **Multimodal Transportation: Development of a Performance-Based Planning Process,** Research Results Digest 226, Transportation Research Board, NRC

_____ **Systems for Design of Highway Pavements,** Research Results Digest 227, Transportation Research Board, NRC

_____ **Long-Term Monitoring of Pavement Maintanence Materials Test Sites,** FHWA-RD-98-073, USDOT Research and Development

_____ **Soil-Vapor Versus Discrete Soil Sample Measurementsfor VOCs in the Near-Surface Vadose Zone-Feasability Study,** CRREL Special Report 98-7

_____ **Retrofit Load Transfer,** FHWA, USDOT, FHWA-SA-98-047

_____ **University Research Center Phase 1,** Arizona DOT, FHWA-AZ98-472(1)

Videos for Loan

_____**Employee Orientation Video, City of Aurora,** *KACT-TV Channel 8 Aurora, Colorado*

_____**When Disaster Strikes, Emergency Relief for Federally-Owned Roads,** *FHWA Federal Lands Highways*

_____**Workshop on Transportation Finance 1, 2, & 3,** *Transportation Research Board*

_____**Forum on Major Factors Affecting Asphalt Concrete Pavement Performance 1 & 2,** *Transportation Research Board*

CD-ROM for Loan

_____**Resource Guide of the Implementation of Linear Referencing Systems on Geographic Information Systems,** *Bereau of Transportation Statistics,USDOT*

These materials may be borrowed for three weeks. However, if you need them longer, contact our office for an extension. Contact **Christel Kennedy** at (907) 451-5320 or TDD: (907) 451-2363.

Please print your name and address below, and mail, fax, or E-mail to:

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Applications of GPS for Surveying and Other Positioning Needs in Departments of Transportation, NCHRP Synthesis 258. *Robert Czerniak, Ph.D., James P. Reilly, Ph.D..* This synthesis presents a description of GPS, major components, functions, basic geodesic principles, and how it can be applicable to the data and analysis requirements of transportation agencies, as well as cost effectiveness and current and more advanced applications of GPS by DOTs.

National Automated Highway System Research Program, A Review. *Transportation Research Board.* This report covers the response, as well as support and background, to four questions presented by the DOT ITS Joint Program Office. The questions were: given what has been learned to date, is the National Automated Highway System Research Program vision and mission still worthy of major research investment; are there elements of this research that should be continued in the Intelligent Vehicle Initiative; in representing a new approach for conducting research & development, has NAHSC been effective & efficient; and is there an appropriate role for this consortium in the Intelligent Vehicle Initiative.

Maintenance Issues and Alternate Corrosion Protection Methods for Exposed Bridge Steel, NCHRP Synthesis 257. *Tom W. Neal, Jr..* This National Cooperative Highway Research Program synthesis describes current practice regarding maintenance and protection strategies for exposed structural steel on existing bridges. The information would be of interest to DOT bridge maintenance engineers, coating specialists, chemists, researchers, as well as manufacturers and suppliers of corrosion protection products and systems.

Bridge Rating Using KDOT FWD and the Related Methodologies, K-TRAN: KSU-96-1. *Kuo-Kuang Hu, Khalid Niazi, M. Sureshkumar Iyer, Hani G. Melhem.* This report follows the evaluation of the use of a Falling Weight Deflectometer (FWD) as a tool to provide qualitative measures of the soundness of a bridge. It includes mathematical models as well as several theories and numerical simulations. The report includes the development of the DR-10 computer program for simulating continuous framed structures.

Parks Highway Load Restriction Study Field Data Analysis, Report No. INE/TRC 97.11, and INE/TRC 97.11b, Alaska DOT&PF/University of Alaska Fairbanks. *Lufti Raad.* This report covers the results of analyses to determine road damage under applied traffic loads due to loss of pavement strength during spring thaw. Field data used for the analyses included analysis and comparison of WIM (Weigh in Motion) and scalehouse traffic data; determination of overweight axle loads and vehicles; comparison of north-and southbound traffic and its affect on pavement damage; analysis of round temperature for thaw initiation and propagation; and simulation of the pavement's remaining life with and without load restrictions.

Parks Highway Load Restriction Study Economic Analysis, *Northern Economics.* This study evaluates the economic costs and benefits associated with regulatory changes to the trucking industry and identifies the financial burden to the trucking industry and other Alaskan sectors resulting from current load restrictions.

Pilot Installation of the Dynatest Pavement Management System on the National Highway System, Southeast Region, Alaska Department of Transportation & Public Facilities, *Robert C. Briggs, PE.* This report follows the testing of Dynatest software for pavement management in Alaska. The system received favorable reviews as a result of the study.

1997 Pavement Condition Report, Alaska Department of Transportation & Public Facilities. *R. Scott Gartin, PE, and Tony D. Barter, PE.* This report covers pavement conditions among the three Alaska DOT&PF Regions. Brief descriptions of current pavement management practices used in Alaska are included.

Rapid Replacement of Bridge Decks, NCHRP Report 407. *Maher K. Tadros, Mantu C. Baishya.* The report describes the work performed by the University of Nebraska-Lincoln under Project 12-41 and discusses several means for expediting the removal of existing bridge decks. The information will be particularly helpful to highway agencies and is recommended by AASHTO as recommended practices.

Using Electrical Properties to Classify the Strength Properties of Base Course Aggregates, Texas Transportation Institute, Research Report 1341-2. *Timo Saarenketo, and Tom Scullion.* This report describes the deformation properties and frost susceptibility of base core aggregates as shown by dielectric value and electrical conductivity.

The Role of Federal-aid Division in Highway Safety, Safety at a Crossroad, *Office of Highway Safety*. This report describes the findings of a review to identify the tasks, functions, and activities that the Federal-aid Division currently performs related to highway safety. The key finding is that there is inconsistency in the field's activities.

Electronic Lien Titling, Texas Transportation Institute Research Report 3913-S. *Robert N. Reinhardt.* This report covers research to identify the current users of electronic lien and titling systems throughout the United States and evaluated the applicability of the method used for inclusion in a Texas Electronic Lien and Titling (ELT) system.

Social, Economic, & Environmental Effects of Elevated, Depressed, & At-Grade Level Freeways in Texas, Texas Transportation Institute Research Report 1327-6F. *Jesse L. Buffington, Sharada R. Vadali, Katie N. Womack, Richard A. Zimmer, Wayne G. McCully, Michael Nikolaou, & Carol A. Lewis.* This report is a summary of the findings of a four year study estimating the social, economic, and environmental effects of proposed elevated and/or depressed freeway improvements. The study found that freeway grade level differences in selected measures of social and economic activity are statistically significant, and depend largely on various locational factors.

Innovative Materials & Design of Soundwalls, Texas Transportation Institute Research Report 2968.S. *Paul N. Roschke, H.-Y. Yeh, and Steven Esche.* The report follows a study of the feasibility of using recycled plastics to construct soundwalls. Data from analysis of a field test are included.

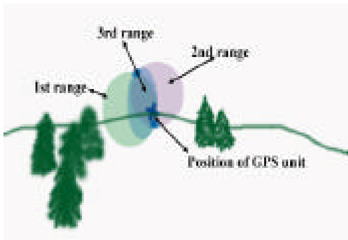
A Test Method for Identifying Moisture Susceptible Asphalt Concrete Mixes, Research Report 1455-2F. *Muhammad Murshed Alam, MSCE, Nalini Vemuri, MSCE, Vivek Tandon, Ph.D., Soheil Nazarian, Ph.D., PE, & Miguel Picornell, Ph.D., PE.* This report covers the study of the Environmental Conditioning System developed by the Strategic Highway Research Program (SHRP). Several modifications to the original system are proposed and results from preliminary evaluation are included.

Work Zone-Related Traffic Legislation: A Review of National Practices & Effectiveness, Texas Transportation Institute Research Report 1720-1. *Gerald L. Ullman, Paul J. Carlson, Nada D. Trout, and J. Alan Parham.* This report includes information from a study to identify and asses work zone-related legislation implementation nationwide. This includes legislation that has been passed, implementation characteristics & issues encountered, analysis of the effect of the legislation on work zone accidents, & enforcement characteristics & issues encountered.

Airport System Capital Requirements, Transportation Research Circular No. 485. This report covers the proceedings of the Transportation Research Board's workshop of the same name. Topics include presenting, comparing, and discussing estimates of airport system capital needs, and how current sources are allocated to meet needs, and whether the sources are adequate to meet both current & forecast demands.

continued from page 1

and receives signals from, satellites that allow it to determine its position based on the distance in degrees from a north reference point. GPSs determine a position by getting a range at a specific time



from a satellite. If, at the same instant that the first range is taken, the GPS can also measure the distance to a second satellite, a second "sphere of position" can be determined. A third range gives a third sphere, and so forth. In general, there will be few places where all the spheres meet. For example, two spheres can intersect along a circle; three spheres can coincide only at two points. One of these points typically represents an unreasonable solution to the navigation problem (it may be deep within the earth or far out in space), so three satellite ranges are sufficient to give one's exact position.

How Are People Using GPS?

With each passing week, people seem to find clever new applications for satellite positioning. Highway agencies have found a myriad of uses, as other articles in this newsletter indicate. Meteorologists measure the delays in GPS signals caused by the atmosphere to aid in weather forecasting. Farmers survey the condition of each square yard of their fields so that they can distribute fertilizer efficiently. Also, GPS radio receivers guide ships into foggy harbors or passenger cars along unfamiliar roads. The holding yards of Singapore's busy port use satellite positioning to keep track of the placement of cargo containers as they are shuffled around. With GPS surveying equipment, geologists can measure the subtle shifts in the earth's crust—movements of just a few millimeters—that show the motion of the planet's tectonic plates and help to define the location and extent of earthquake-prone zones.•

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